DE 3314442 A1

54 Electronic cycle thermometer

The invention relates to an electronic cycle thermometer based on a microprocessor to support natural birth control methods. An electronic thermometer is provided whose electrical output signals are supplied to a microprocessor circuit (6) containing memory, arithmetic and clock circuits (14). To be able to assess the individual phases of the cycle reliably, the microprocessor circuit has a graphical analogue display (3) connected to it for the curve of the temperature values (T) over a time period corresponding to at least one cycle. By entering the start of the cycle (X), the frequency distribution (F) for the start of the fertile phase can be displayed over a plurality of cycles in sync with the representation of the temperature curve.

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Electronic cycle thermometer

The invention relates to an electronic cycle thermometer in accordance with the precharacterizing clause of Patent Claim 1.

Such cycle thermometers are known, for example, from European Patent Application 31 251 and from US-A 4 151 831. They are intended to provide a woman with the option of natural birth control without using measures which have a direct effect on human bodily events, such as chemical and mechanical aids. Natural birth control is based on the fact that the basal body temperature of a woman at the time of ovulation rises significantly by a certain level. Conception can only occur within the five days prior to the day of the rise in temperature. As a safety zone, the literature recommends a period of six days before and three days after the day of the rise in temperature. The three days "after" are merely intended to ensure that the rise in temperature, which was indeed observed, is related to ovulation rather than being "chance".

Known electronic cycle thermometers operate with a microprocessor circuit connected to an electronic thermometer to measure the basal body temperature. From the start of the first day of each cycle, which is to be entered into the microprocessor, the woman measures her basal body temperature daily before getting up, as far as possible always at the same time, using the electronic thermometer, and this temperature is entered into a memory circuit in the microprocessor. The data for a plurality of cycles can then be used to display the fertile and infertile days, e.g. using differently coloured lamps.

The cycle thermometer disclosed in US-A 4 151 831 can also have a printer connected to it which transfers the temperature values stored for a

cycle to a file card. The temperature values can then be connected by a line whose curve can be used to draw conclusions about the individual cycle phases. The possibility of graphically representing the temperature curve for one or more cycles will generally be left to the doctor, because the printer to be connected to the cycle thermometer is large and expensive.

The invention is based on the object of specifying an electronic cycle thermometer of the type under discussion which can be used to show the individual cycle phases clearly in order thus to allow the user herself to assess the fertile and infertile phases.

The invention achieves this object by means of the features specified in the characterizing part of Patent Claim 1.

On the basis of these features, the electronic cycle thermometer has a graphical analogue display connected to the microprocessor, preferably a liquid crystal display, which shows the whole temperature curve over a time period corresponding to the duration of at least one cycle. Furthermore, the start of the cycle is indicated in each case. This provides a woman with a clear representation of the particular cycle course and allows her to make her own decision about birth control. This is consciously not done by the microprocessor, since it is assumed that a technical appliance cannot indicate the fertile phases with sufficient certainty and exactitude when assessing physiological parameters.

To aid decision-making for determining the fertile phase, the frequency distribution for the individual cycle lengths can be used. This is plotted above the same time axis of the temperature curve, with the zero point of the scale situated at the start of the past cycle. Instead of directly indicating the frequency distribution for the cycle lengths, the frequency distribution for a cycle day which is firmly associated with the respective cycle end and has a high

probability of corresponding to the start of the fertile phase is displayed. As an example, this may be the cycle day which is 20 days before the cycle end. This procedure is acceptable because the period of time between ovulation and the subsequent menstruation is very constantly 14 days. The possibility of becoming pregnant can no longer be neglected a further six days before ovulation, so that the twentieth day before the end of the cycle can be taken as the start of this phase. The essential feature here is not the choice of a particular cycle day but rather that the frequency distribution is displayed, which shows how frequently in the past the fertile phase began on which cycle day. The position of the frequency distribution's maximum reveals the day on which the fertile phase began most frequently in the past, on the basis of the above definition.

The analogue display shows the curve for the temperature values from the start of the cycle to the present day. Liquid crystal displays (LCDs) available today are easily able to output 84 successive values, i.e. equivalent to over two months, in a small space. Since the display normally shows only the temperature values for the present cycle, but a woman often wants an overview of past cycles, an option is provided for the temperature graphs for individual past cycles to be shown on the display. In this case, the values of no more than five past cycles shall be stored.

The invention is explained in more detail in an illustrative embodiment with the aid of the drawings, in which:

Figure 1 schematically shows a perspective view of an electronic cycle thermometer in accordance with the invention, and

Figure 2 shows a block diagram for the cycle thermometer.

A cycle thermometer 1 has a housing 2 with the approximate size of a conventional travel alarm clock, whose front has a liquid crystal display 3 and a

keypad 4 with, in this case, eight input keys 4a to 4h, e.g. touch keys or the like.

In this case, the liquid crystal display 3 is a dot matrix with 32 matrix dots in the ordinate direction and 32 matrix dots in the abscissa direction. Numbers from 0 to 32, corresponding to individual days, are marked continuously on the abscissa and the top half of the ordinate shows temperature values in tenths of degrees while the bottom half of the ordinate shows continuous digits from 0 to 10 to distinguish a frequency distribution.

The keys 4a to 4h on the keypad 4 and a function key 5 provided on the top of the housing affect a microprocessor circuit 6 surrounded by dashes in Figure 2. Key 4a can be used to set the time t and, by additionally pressing the function key 5, the wake-up time. Hours h and minutes m are set by pressing the function key 5 and keys 4c and 4d. Key 4e is an input key which can be used to enter temperature values into the microprocessor 6 when the function key 5 is pressed at the same time. Key 4e is simultaneously a display lamp. The X-key 4f is used to mark the start of the cycle when the function key 5 is pressed at the same time. The two further, Y- and Z-keys 4g and 4h, respectively, are used for entering further markings. In addition, another display key 4b, identified by A, is provided and can be used to select what is to be shown on the display 3.

On the right-hand narrow side of the housing 2, an electronic thermometer is mounted on a loop 7 which can be pulled out, said electronic thermometer being used to measure the basal body temperature orally. In addition, a miniature loudspeaker 8 or other sound generator used to emit a bleeping sound is also integrated in the housing.

Figure 2 shows the block diagram of the cycle thermometer. The microprocessor circuit 6 has a clock 9 with an alarm circuit which is connected to the display 3. The display 3 normally shows the time of

day, and the respectively set time when the time or wake-up time is set using the aforementioned adjustment function time keys 4a, 4c and 4d in conjunction with the function key 5.

The thermometer 7 is connected to a measurement and converter circuit 10 which processes the temperature values in line with the processor and additionally indicates when temperature measurement has ended. This measurement and converter circuit is connected to the display lamp integrated in the key 4e and to the miniature sound generator 8. If the measurement process has ended, the lamp 4e flashes and/or the miniature loudspeaker emits a bleeping sound. The temperature value measured with the thermometer 7 can then be transferred to the microprocessor by pressing the E- or input key 4e while pressing the function key 5 at the same time. However, this can only be done within a certain time window. To this end, the microprocessor circuit 6 is provided with a time window circuit 11 and a gate circuit 12. The time window is permanently set and covers, by way of example, the times between 6 o'clock and 10 o'clock in the morning. To evaluate the temperature values and the temperature curve conclusively, the temperature is intended always to be measured at the same wake-up time. Since this is generally not always possible, a time correction circuit 13 is provided. It is known that the basal body temperature is overlapped by a circadian temperature curve, a very good approximation of which can be given by a straight line with a gradient of approx. 0.1° per hour within the aforementioned time window. The time correction circuit can then relate the measured temperature values to a fixed instant using a simple set of arithmetic instructions. This fixed instant can either be stipulated within the circuit, or an instant is chosen which is most frequently chosen as the wake-up time or as the temperature or measurement instant, for example. Only a temperature value which is entered within the

time window and is corrected to the aforementioned fixed instant is transferred to an arithmetic and memory circuit 14 in the microprocessor. Independently of the transfer to the arithmetic and memory circuit 14, the temperature, be it body temperature or else room temperature, can be shown digitally on the display 3 as a result of an appropriate selection using the display key 4b.

The arithmetic and memory circuit 14 has a plurality of function blocks 15, 16 and 17. Block 15 is an input/output block roughly like an open shift register, to which the corrected temperature values for the basal body temperature and the signals from the input keys 4f, 4g and 4h are transferred. This block 15 is connected via a bidirectional data line to an evaluation circuit 16 which statistically evaluates all the values entered. A memory 17 is connected to this evaluation circuit, likewise via a bidirectional data line, and stores all the values required for long-term observation. The arithmetic and memory circuit 14 is connected to the liquid crystal display via the block 15. The functions to be shown can, in turn, be called up via the open shift register 15 by appropriately pressing the display key A. The function blocks formed are integrated, in terms of circuitry, in the microprocessor circuit.

The cycle thermometer is powered by batteries (not shown here), with protection against the data stored being lost when the battery is changed.

The cycle thermometer is expediently set for the first time at the start of a new cycle. On waking up, the thermometer 7 is immediately pulled out and placed in the mouth. The basal body temperature is measured with the mouth closed. As soon as the measurement is finished, the key lamp 4e flashes and/or the miniature loudspeaker 8 emits the bleeping sound. By pressing the function key 5 and the input key 4e, the measured temperature value is transferred to the microprocessor. After possible time correction, the

corrected value for the basal body temperature is written to the memory 17 via the block 15 and the evaluation circuit 16. The measured value can be shown digitally on the display 3 by pressing the display key 4b accordingly. By pressing the display key 4b further, the measured value can likewise be shown as a matrix dot on the graphical display. In this context, the temperature value transferred to the memory in each case appears at the outermost right-hand edge of the display panel 3, and, accordingly, corresponds to the dot denoted by T in Figure 1.

On the basis of the time window, the temperature can also be measured several times and entered in the microprocessor. In this context, it is ensured that only the last value entered is stored in each case. At the end of the time stipulated by the time window, temperature values cannot be transferred. In addition, within the time window, only temperature values between 36.0 and 37.5°C can be transferred; this means that it is virtually impossible to make unintentional entries within the time window, for example to enter the room temperature, which is also to be displayed otherwise.

On the next day, at the start of the time window, the open shift register 15 is cyclically advanced by one memory location. If the unit is now switched over to the matrix display for the temperature, then the right-hand edge of the image has a gap, i.e. a day column, which contains no temperature value. The value measured on the previous day is shifted one place to the left. Accordingly, a gap in the last day column means that temperature measurement has not yet taken place; if this day column already contains a matrix dot, then the temperature has already been measured and transferred to the memory.

After the first 32 days, all the day columns are filled with temperature dots in accordance with the digits on the abscissa. Measured temperature values continue to be transferred and also stored, but only

the last 32 days' temperatures are ever displayed. However, it is also possible to display the temperatures from days further back by cycling through the shift register, for example by pressing the display key 4b in conjunction with the function key 5, or by using a separate key.

The X-key 4f is used to enter the respective start of a cycle into the evaluation circuit 14. This start of a cycle X is shown on the display, together with the temperature curve, by means of four dots one below the other, for example. Figure 1 shows the previous start of a cycle, specifically in the first day column, while the start of the new cycle can be seen at the right-hand edge of the display 3. In addition, the display shows markings Y and Z, which are identified by two dots and by one dot, respectively, and have been entered using the Y- and the Z-key 4g and 4h, respectively. These markings can be freely selected to identify particular occurrences.

While markings Y and Z merely represent visual memory aids, the X-marking has a functional significance for the start of a cycle: it is used to calculate the cycle duration. As soon as this mark is set, the cycle duration is calculated on the basis of the distance in time from the previous X-marking. The value calculated in the evaluation circuit 14 is used, together with the other values from the past, to reconstruct a frequency distribution F. The latter is now indicated together with the temperature curve on the liquid crystal display 3, the time axis being common to the two graphs. Instead of displaying the distribution for the full cycle duration, the distribution over the start of the fertile phase is shown. For calculation, the procedure here is such that 14 days of premenstrual phase are first deducted from the duration of the whole cycle, and then a further six days, which are appended as a safety zone before ovulation. After a certain number of cycles, an image roughly like the one in Figure 1 is produced. The

frequency distribution F there is at its maximum on the tenth day, which means that the fertile phase began most frequently in the past on the tenth day. The height of the individual columns corresponds directly to the number of cycle days or is proportional to the number of these cycle days on which the fertile phase began. The graph of frequency distribution F is updated each time a cycle starts, by pressing the X-key.

For long-term calculation, temperature values for the past three months are stored, for example. The data for the frequency distribution F for the start of the fertile days is retained, however. Assessing the temperature graph and the graph of frequency distribution allows much more reliable conclusions to be drawn about the start of the fertile phase than with known methods.

The embodiment described is an example. The microprocessor circuit does not need to have its own shift register circuit, for example. The graphical display would then not be shifted cyclically; the first temperature value at the start of the cycle is displayed at the left-hand edge of the display, for example, and the temperature value for the following day appears in the column to the right of this. Thus, the new temperature values and markings and the values for the frequency distribution continue to be written to the right until the cycle key is pressed again at the start of a cycle and this display process is repeated.

The number of grid points on the liquid crystal display is also an example. Depending on the product, 32 × 84 grid point displays are also available, for example. The number of function keys can also be changed. Thus, for example, it is possible to get by with just a single or just a few multifunction key(s). Under the control of the microprocessor, the functions are passed through cyclically and indicated on the liquid crystal display. The function where the key is

released remains active. These multifunction keys can be in the form of touch keys.

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Patent Claims

1. Electronic cycle thermometer based on a microprocessor to support natural methods of birth control, having a thermometer which supplies electrical temperature output signals and is used for measuring the basal body temperature, a microprocessor circuit which is coupled to the thermometer and is used for storing and processing the temperature values entered once daily, and having an input keyboard for the microprocessor circuit, characterized in that the microprocessor circuit (6) has a graphical analogue display (3) connected to it for the curve of the temperature values (T) over a time period corresponding to at least one cycle.

2. Cycle thermometer according to Claim 1, characterized in that the analogue display (3) is a liquid crystal display which has a graphical capability and is arranged in a matrix.

3. Cycle thermometer according to one of the preceding claims, characterized in that the input keypad (1) has a function (4f) for entering the respective start of the cycle, and in that this day is marked (marking X) on the analogue display (3).

4. Cycle thermometer according to Claim 3, characterized in that the input function (4f) for the start of a cycle is connected to a memory and arithmetic circuit (14) for calculating and storing the respective cycle lengths, and in that the analogue display shows the frequency distribution (F) for cycle days which are to be firmly associated with the calculated cycle lengths in each case.

5. Cycle thermometer according to Claim 4, characterized in that the firm cycle day fixed is the 20^{th} day before the end of the cycle in each case.

6. Cycle thermometer according to one of the preceding claims, characterized in that the microprocessor circuit (6) has a memory circuit (15)

for retrieving and displaying the values (T, F, X, Y, Z) over a plurality of past cycles.

7. Cycle thermometer according to one of the preceding claims, characterized in that further markings (Y, Z) for identifying particular occurrences are provided on the graphical analogue display (3).

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Figure 1

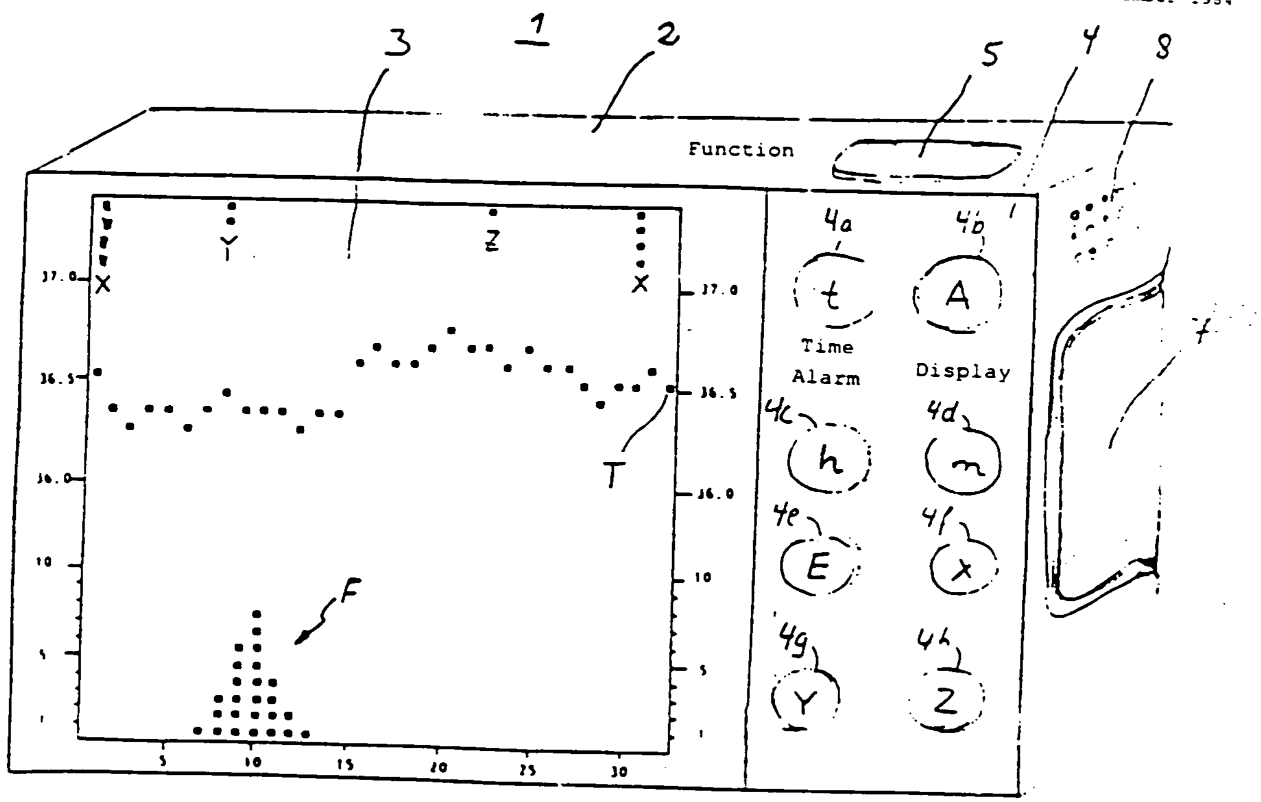
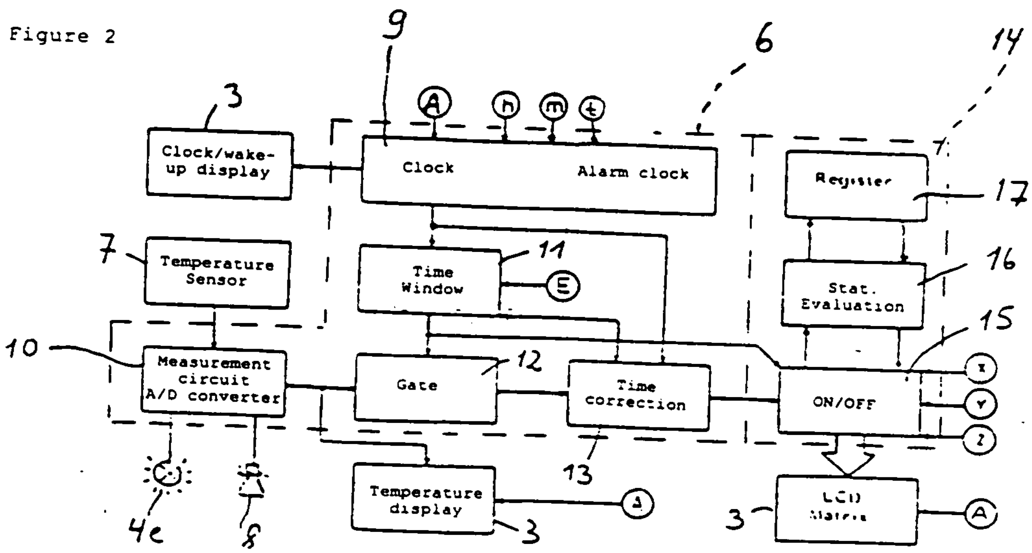


Figure 2



Translator's Report/Comments

Your ref: DE 3314442A1 Your order of (date): 23.2.00

In translating the above text we have noted the following apparent errors/unclear passages which we have corrected or amended:

Page/para/line*	Comment
6/-1	4d → 4g

* This identification refers to the source text. Please note that the first paragraph is taken to be, where relevant, the end portion of a paragraph starting on the preceding page. Where the paragraph is stated, the line number relates to the particular paragraph. Where no paragraph is stated, the line number refers to the page margin line number.

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